



National
Aeronautics and
Space
Administration

NASA Scientific and Technical Document Availability Authorization (DAA)

The DAA approval process applies to all forms of published NASA Scientific and Technical Information (STI), whether disseminated in print or electronically. It is to be initiated by the responsible NASA Project Officer, Technical Monitor, author, or other appropriate NASA official for all presentations, reports, papers, and proceedings that contain NASA STI. Explanations are on the back of this form and are presented in greater detail in NPG 2200.2, "Guidelines for Documentation, Approval, and Dissemination of NASA Scientific and Technical Information."

☐ Original
☐ Modified

I. DOCUMENT/PROJECT IDENTIFICATION

| | |
|---|------------------------------|
| TITLE Avifauna of an Unimpounded Salt Marsh on Merritt Island. | AUTHOR(S) Breining, D. R. |
|---|------------------------------|

| | |
|---|--|
| ORIGINATING NASA ORGANIZATION Kennedy Space Center Biomedical Office | PERFORMING ORGANIZATION (if different) Dynamac Corporation, KSC |
|---|--|

| | | |
|--|---|-----------------------|
| CONTRACT/GRANT/INTERAGENCY/PROJECT NUMBER(S) | DOCUMENT NUMBER(S) Florida Field Naturalist 25: 1-10 | DOCUMENT DATE 1997 |
|--|---|-----------------------|

For presentations, documents, or other STI to be externally published (including through electronic media), enter appropriate information on the intended publication such as name, place, and date of conference, periodical, or journal name, or book title and publisher in the next box. These documents must be routed to the NASA Headquarters or Center Export Control Administrator for approval (see Sections III and VIII).



II. SECURITY CLASSIFICATION

CHECK ONE (One of the five boxes denoting Security Classification must be checked.)

☐ SECRET ☐ SECRET RD ☐ CONFIDENTIAL ☐ CONFIDENTIAL RD ☒ UNCLASSIFIED

III. AVAILABILITY CATEGORY

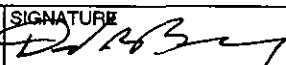
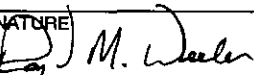

| | |
|--|---|
| <input type="checkbox"/> ITAR <input type="checkbox"/> EAR | Export Controlled Document - USML Category Classification Number (ECCN) (Documents marked in this block must have the concurrence/approval of the NASA Headquarters or Center Export Control Administrator (see Section VIII).) |
| <input type="checkbox"/> TRADE SECRET <input type="checkbox"/> SBIR <input type="checkbox"/> COPYRIGHTED | Confidential Commercial Document (check appropriate box at left and indicate below the appropriate limitation and expiration): <input type="checkbox"/> U.S. Government agencies and U.S. Government agency contractors only <input type="checkbox"/> NASA contractors and U.S. Government only <input type="checkbox"/> U.S. Government agencies only <input type="checkbox"/> NASA personnel and NASA contractors only <input type="checkbox"/> NASA personnel only <input type="checkbox"/> Available only with the approval of issuing office: <input type="checkbox"/> Limited until (date) |
| <input checked="" type="checkbox"/> PUBLICLY AVAILABLE | Publicly available documents must be unclassified, may not be export controlled, may not contain trade secret or confidential commercial data, and should have cleared any applicable patents application process. |

IV. DOCUMENT DISCLOSING AN INVENTION

| | | |
|--|---|------|
| THIS DOCUMENT MAY BE RELEASED ON (date) | NASA HQ OR CENTER PATENT OR INTELLECTUAL PROPERTY COUNSEL SIGNATURE | DATE |
|--|---|------|

V. BLANKET RELEASE (OPTIONAL)

- ☐ All documents issued under the following contract/grant/project number may be processed as checked in Sections II and III.
- ☐ The blanket release authorization granted on (date)
- ☐ is RESCINDED - Future documents must have individual availability authorizations.
- ☐ is MODIFIED - Limitations for all documents processed in the STI system under the blanket release should be changed to conform to blocks as checked in Sections II and III.

| VI. AUTHOR/ORIGINATOR VERIFICATION | | | |
|---|----------------------|---|-----------------|
| I HAVE DETERMINED THAT THIS PUBLICATION: | | | |
| <input type="checkbox"/> DOES contain export controlled, confidential commercial information, and/or discloses an invention for which a patent has been applied, and the appropriate limitation is checked in Sections III and/or IV. | | | |
| <input checked="" type="checkbox"/> does NOT contain export controlled, confidential commercial information, nor does it disclose an invention for which a patent has been applied, and may be released as indicated above. | | | |
| NAME OF AUTHOR/ORIGINATOR David Breininger | MAIL CODE DYN-2 | SIGNATURE  | DATE 4/7/98 |
| VII. PROJECT OFFICER/TECHNICAL MONITOR/DIVISION CHIEF REVIEW | | | |
| <input checked="" type="checkbox"/> APPROVED FOR DISTRIBUTION AS MARKED ON REVERSE <input type="checkbox"/> NOT APPROVED | | | |
| NAME OF PROJECT OFFICER OR TECH. MONITOR RAYMOND M. WHEELER | MAIL CODE JTG | SIGNATURE  | DATE 4/9/98 |
| VIII. EXPORT CONTROL REVIEW/CONFIRMATION | | | |
| <input checked="" type="checkbox"/> Public release is approved <input type="checkbox"/> Export controlled limitation is not applicable | | | |
| <input type="checkbox"/> Export controlled limitation is approved <input type="checkbox"/> Export controlled limitation (ITAR/EAR) marked in Section III is assigned to this document: | | | |
| USML CATEGORY NUMBER | CCL ECCN NUMBER | HQ OR CENTER EXPORT CONTROL ADMINISTRATOR (as applicable) Dennis L. Miller | DATE 4/16/98 |
| IX. PROGRAM OFFICE OR DELEGATED AUTHORITY REVIEW | | | |
| <input checked="" type="checkbox"/> APPROVED FOR DISTRIBUTION AS MARKED ON REVERSE <input type="checkbox"/> NOT APPROVED | | | |
| NAME OF PROGRAM OFFICE REPRESENTATIVE Audrey Lee Silipo | MAIL CODE FF-S2-A | SIGNATURE  | DATE 4/14/98 |
| X. DISPOSITION | | | |
| THIS FORM, WHEN COMPLETED, IS TO BE SENT TO YOUR CENTER PUBLICATIONS OFFICE | | | |

INSTRUCTIONS FOR COMPLETING THE NASA SCIENTIFIC AND TECHNICAL DOCUMENT AVAILABILITY AUTHORIZATION (DAA) FORM

Purpose. This DAA form is used to prescribe the availability and distribution of all NASA-generated and NASA-funded documents containing scientific and technical information (including those distributed via electronic media such as the World Wide Web and CD-ROM).

Requirements. The author/originator must provide either a suitable summary description (title, abstract, etc.) or a completed copy of the document with this form. This form is initiated by the document author/originator and that individual is responsible for recommending/determining the availability/distribution of the document. The author/originator completes Sections I through III, and VI. The author/originator is also responsible for obtaining information and signature in Section IV to the extent the document discloses an invention for which patent protection has been applied. Subsequent to completion of these sections, the author/originator forwards the document to the appropriate Project Manager/Technical Monitor/Division Chief for further review and approval in Section VII, including a re-review of the planned availability and distribution. Once this approval is obtained, the DAA is forwarded to the NASA Headquarters or Center Export Administrator for completion of Section VIII. It is then forwarded for completion of Section IX to the cognizant NASA Headquarters Program Office or Delegated Authority, who provides final review and approval for release of the document as marked.

When to Use This Form. Documents containing STI and intended for presentation or publication (including via electronic media) must be approved in accordance with the NASA STI Procedures and Guidelines (NPG 2200.2). Documents that are to be published in the NASA STI Report Series must be coordinated with the appropriate NASA Headquarters or Center Scientific and Technical Information Office in accordance with NPG 2200.2. Note that information on the Report Documentation Page (if attached) is not to be entered on the DAA except for title, document date, and contract number.

How to Use this Form. Specific guidelines for each section of this form are detailed below.

I. Document/Project Identification. Provide the information requested. If the document is classified, provide instead the security classification of the title and abstract. (Classified information must not be entered on this form). Include RTOP numbers on the Contract/Grant/Interagency/Project Number(s) line. Provide information on presentations or externally published documents as applicable.

II. Security Classification. Enter the applicable security classification for the document. Documents, if classified, will be available only to appropriately cleared personnel having a "need to know."

III. Availability Category for Unclassified Documents. Check the appropriate category or categories.

Export Controlled Document. If the document is subject to export restrictions (see NPG 2200.2, paragraph 4.5.3), the appropriate restriction must be checked, either International Traffic in Arms Regulations (ITAR) or Export Administration Regulations (EAR), and the appropriate United States Munitions List (USML) category or Commerce Control List (CCL), Export Control Classification Number (ECCN) must be cited.

Confidential Commercial Documents (Documents containing Trade Secrets, SBIR documents, and/or Copyrighted Information). Check the applicable box (see NPG 2200.2 paragraph 4.5.7). When any of these boxes are checked, also indicate the appropriate limitation and expiration in the list to the right of these restrictions. These limitations refer to the user groups authorized to obtain the document. The limitations apply both to the initial distribution of the documents and the handling of requests for the documents. The limitations will appear on and apply to reproduced copies of the document. Documents limited to NASA personnel should not be made available to onsite contractors. If the Available Only With the Approval of Issuing Office limitation is checked, the NASA Center for Aerospace Information will provide only bibliographic processing and no initial distribution; CASI will refer all document requests to the issuing office.

Publicly Available Document - Unrestricted Distribution. Check this box if the information in the document may be made available to the general public without restrictions (unrestricted domestic and international distribution). If the document is copyrighted (see paragraph 4.5.7.3 in NPG 2200.2), also check the "Copyrighted" box in this section.

IV. Document Disclosing an Invention. This must be completed when the document contains information that discloses an invention (see NPG 2200.2, paragraph 4.5.9). When this box is checked, an additional appropriate availability category must be checked. Use of this category must be approved by NASA Headquarters or Center Patent Counsel or the Intellectual Property Counsel.

V. Blanket Release (Optional). Complete this optional section whenever subsequent documents produced under the contract, grant, or project are to be given the same distribution and/or availability as described in Sections II and III. More than one contract number or RTOP Number can be entered. This section may also be used to rescind or modify an earlier Blanket Release. All blanket releases must be approved by the Program Office or its designee and concurred with by the Office of Management Systems and Facilities.

VI. Author/Originator Verification. Required for all DAA forms.

VII. Project Officer/Technical Monitor/Division Chief Review. The Project Officer/Technical Monitor/Author or Originator Division Chief or above must sign and date the form. The office code and typed name should be entered.

VIII. Export Control Review/Confirmation. This section is to be completed by the authorized NASA Headquarters or Center Export Control Administrator for all documents.

IX. Program Office or Delegated Authority Review. This section is to be completed by the duly authorized official representing the NASA Headquarters Program Office. Any delegation from NASA Headquarters to a NASA Center in accordance with NPG 2200.2 should be entered here.

X. Disposition. For NASA Center use.

Florida Field Naturalist

PUBLISHED BY THE FLORIDA ORNITHOLOGICAL SOCIETY

VOL. 25, No. 1

FEBRUARY 1997

PAGES 1-32

Fla. Field Nat. 25(1):1-10, 1997.

AVIFAUNA OF AN UNIMPOUNDED SALT MARSH ON MERRITT ISLAND

DAVID R. BREININGER

DYN-2, The Dynamac Corporation

NASA Biomedical Operations Office

John F. Kennedy Space Center, Florida 32899

Abstract.—Variable circular plots were used to quantify avian composition and abundance in an unimpounded salt marsh. There were 31 avian species of conservation concern observed using the marsh for resting, feeding, or breeding. A high species richness (89 species) and density of birds (15 birds per ha) used the marsh.

Few studies have quantified the avian species composition of the salt marshes that border much of Florida's coastline (Engstrom 1992). Few studies of avian species composition in saline environments have been published in North America (Burger et al. 1992, Weller 1994). The objective of this paper is to quantify avian composition within several remnants of unimpounded salt marsh that occur along the estuarine edges of the Indian River lagoon system on Merritt Island.

Most salt marshes that remain along the Indian River are impounded for mosquito control or are highly fragmented due to human activities (Larson 1995). Impoundment could have benefited most bird species (see Provost 1969), but contributed to the extinction of the Dusky Seaside Sparrow (*Ammodramus maritimus nigrescens*) (Sykes 1980, Kale 1988) and the reduction of Black Rail populations on Merritt Island (Sykes 1978). Impounded salt marshes often have higher bird densities and biomass than do unimpounded marshes because there is more shallow, open water in impoundments (Trost 1968, Provost 1968, Burger et al. 1992, Smith and Breininger 1995). Unimpounded salt marshes on Merritt Island were described as "avian deserts" (Provost 1969).

STUDY AREA AND METHODS

The Indian River Lagoon watershed, an estuary of national significance, occurs between barrier islands and the mainland of central Florida's Atlantic coast (DeFreese

1991). This coastal zone of central Florida is the southern transition between grassy marshes to the north and mangrove swamps to the south (Schmalzer 1995). Merritt Island National Wildlife Refuge includes much of the northern Indian River Lagoon complex. Estuarine water levels on Merritt Island are influenced by wind-driven tides, rainfall, and evapotranspiration, but not ocean tides. The marsh occurred adjacent to Gator Hole, an estuarine water located at the northern extent of the Banana River estuarine lagoon. Seven stations were located in the marsh 100-200 m from the open water estuary and at least 200 m apart from each other.

Scientific nomenclature follows Wunderlin (1982) for plants and American Ornithologists' Union (1983) for birds. Salt pans, that were occasionally flooded, comprised 1/5 of the marsh; mangroves (*Avicennia germinans*) comprised 1/5 of the marsh; short (< 1 m) vegetation (*Distichlis spicata*, *Salicornia* spp., *Batis maritima*, *Borrchia frutescens*, *Spartina alterniflora*, and *Juncus roemerianus*) comprised 3/5 of the marsh. Small, permanently flooded pools (< 0.3 ha) were scattered among the vegetation. All seven stations included pools, salt pans, mangroves and most or all of the short vegetation from above. Remnants of such heterogeneous vegetation are common along the estuary (Larson 1995, Schmalzer 1995).

The variable circular plot (VCP) method (Reynolds et al. 1980) was selected to survey birds because of its advantages in patchy habitat (Breininger 1990, 1992; Breininger and Schmalzer 1990, Breininger and Smith 1992). Each station was surveyed eight times. Survey periods were spring 1985 (26 March, 28 March, 7 May, 15 May), summer 1985 (1 July, 8 July, 28 August), fall 1985 (4 September, 3 October, 16 October, 21 November), and winter 1985/1986 (2 December, 22 January, 27 January, 26 February, 27 February). Birds flushed during arrival to the station were tallied, and distances between their flushing location and the station's center point were recorded. All birds seen or heard within seven-minute sampling intervals were recorded, except for those birds that flew over the area without landing (e.g., swallows). Surveys were conducted between one-half hour before sunrise to three hours after sunrise. No surveys were conducted during rain or windy conditions.

The mean number of birds per visit was calculated for every species by summing the total number of detections and dividing by the number of visits (56). Densities were calculated for common species (see below) using an effective detection distance (x) that was determined for each taxon. The x was estimated as the inflection point of a graph of the number of birds per area per band using 10-m concentric bands according to criteria of Reynolds et al. (1980). All ducks, shorebirds, and herons were grouped to determine the x for species within these taxa. The x for all other species was determined separately for each species if the number of observations was greater than 25.

The number of detections were calculated by multiplying the number of singing males by two, unless the total count of all sightings was greater, in which case the total number of sightings was used. Estimates of birds per ha were calculated by summing the number of detections within x , dividing by the number of visits and πx^2 , and multiplying by 10,000 (Reynolds et al. 1980).

RESULTS

Patches of *Spartina alterniflora* were flooded throughout the survey, but *Distichlis spicata* and *Avicennia germinans* were flooded from August to March. The salt pans were flooded in October and November. Thirty-eight species of wintering birds and 51 local breeders used the marsh (Table 1). Wintering species included individuals that were winter residents and individuals present on Merritt Island only during migration (Cruickshank 1980). Most of the local breeders did not nest

Table 1. Bird abundances (mean sightings/visit) of birds sighted within an unimpounded salt marsh on Merritt Island, 1985-1986.

| Common name | Status ^a | Scientific name | Birds/visit ^b |
|-------------------------------------|---------------------|--|--------------------------|
| Red-winged Blackbird | B | <i>Agelaius phoeniceus</i> | 2.96 |
| Willet | B | <i>Catoptrophorus semipalmatus</i> | 1.32 |
| Yellow-rumped Warbler | W | <i>Dendroica coronata</i> | 1.29 |
| Blue-winged Teal | W | <i>Anas discors</i> | 1.21 |
| Rufous-sided Towhee | B | <i>Pipilo erythrophthalmus</i> | 1.07 |
| Least Sandpiper | W | <i>Calidris minutilla</i> | 0.86 |
| Western Sandpiper | W | <i>Calidris mauri</i> | 0.80 |
| Tricolored Heron ^c | B | <i>Egretta tricolor</i> | 0.66 |
| White Ibis ^c | B | <i>Eudocimus albus</i> | 0.63 |
| Common Yellowthroat | W | <i>Geothlypis trichas</i> | 0.61 |
| Boat-tailed Grackle | B | <i>Quiscalus major</i> | 0.54 |
| Royal Tern ^c | B | <i>Sterna maxima</i> | 0.52 |
| Dunlin ^c | W | <i>Calidris alpina</i> | 0.41 |
| Mottled Duck ^c | B | <i>Anas platyrhynchos</i> | 0.39 |
| Unknown <i>Calidris</i> | W | <i>Calidris</i> spp. | 0.38 |
| Semipalmated Plover | W | <i>Charadrius semipalmatus</i> | 0.36 |
| Short-billed Dowitcher ^c | W | <i>Limnodromus griseus</i> | 0.32 |
| Palm Warbler | W | <i>Dendroica palmarum</i> | 0.32 |
| Unknown <i>Anas</i> | W | <i>Anas</i> spp. | 0.21 |
| Northern Cardinal | W | <i>Cardinalis cardinalis</i> | 0.20 |
| American Robin | W | <i>Turdus migratorius</i> | 0.18 |
| <i>Tringa</i> spp. | W | <i>T. melanoleuca</i> and <i>T. flavipes</i> | 0.16 |
| Killdeer | B | <i>Charadrius vociferus</i> | 0.16 |
| Carolina Wren | B | <i>Thryothorus ludovicianus</i> | 0.16 |
| White-eyed Vireo | B | <i>Vireo griseus</i> | 0.14 |
| Unknown sparrow | W | | 0.13 |
| Ruby-crowned Kinglet | W | <i>Regulus calendula</i> | 0.11 |
| Reddish Egret ^c | B | <i>Egretta rufescens</i> | 0.11 |
| Northern Mockingbird | B | <i>Mimus polyglottos</i> | 0.11 |
| Little Blue Heron ^c | B | <i>Egretta caerulea</i> | 0.11 |
| Great Egret ^c | B | <i>Casmerodius albus</i> | 0.09 |
| Common Moorhen | B | <i>Gallinula chloropus</i> | 0.09 |
| Eastern Kingbird | B | <i>Tyrannus tyrannus</i> | 0.09 |
| Snowy Egret ^c | B | <i>Egretta thula</i> | 0.07 |
| Savannah Sparrow | W | <i>Passerculus sandwichensis</i> | 0.07 |
| Northern Bobwhite | B | <i>Colinus virginianus</i> | 0.07 |
| Least Bittern ^c | B | <i>Ixobrychus exilis</i> | 0.07 |
| House Wren | W | <i>Troglodytes aedon</i> | 0.07 |
| Common Ground-Dove | B | <i>Columbina passerina</i> | 0.07 |
| Northern Flicker | B | <i>Colaptes auratus</i> | 0.07 |
| American Black Duck ^c | W | <i>Anas rubribes</i> | 0.07 |

^aB = breeds on Merritt Island, W = species includes individuals that winter on Merritt Island; many individuals may only use Merritt Island during migration.

^bp = species sighted within the marsh while the investigator was transiting among stations, but not sighted while at a station.

^cSpecies of conservation concern (vulnerable to local, regional, or global extinction [Breininger et al. 1994]).

Table 1. (Continued) Bird abundances (mean sightings/visit) of birds sighted within an unimpounded salt marsh on Merritt Island, 1985-1986.

| Common name | Status ^a | Scientific name | Birds/visit ^b |
|--|---------------------|---|--------------------------|
| Prairie Warbler ^c | B | <i>Dendroica discolor</i> | 0.05 |
| Northern Harrier ^c | W | <i>Circus cyaneus</i> | 0.05 |
| Mourning Dove | B | <i>Zenaidura macroura</i> | 0.05 |
| Gray Catbird | W | <i>Dumetella carolinensis</i> | 0.05 |
| Black-bellied Plover ^c | W | <i>Pluvialis squatarola</i> | 0.05 |
| Sharp-tailed Sparrow | W | <i>Ammodramus caudacutus</i> | 0.04 |
| Song Sparrow | W | <i>Melospiza melodia</i> | 0.04 |
| Eastern Phoebe | W | <i>Sayornis phoebe</i> | 0.04 |
| Mallard | W | <i>Anas platyrhynchos</i> | 0.04 |
| Gray Kingbird | B | <i>Tyrannus dominicensis</i> | 0.04 |
| Green Heron | B | <i>Butorides striatus</i> | 0.04 |
| Great Blue Heron | B | <i>Ardea herodias</i> | 0.04 |
| Black-wiskered Vireo ^c | B | <i>Vireo altiloquus</i> | 0.04 |
| Belted Kingfisher | W | <i>Ceryle alcyon</i> | 0.04 |
| Unknown Seiurus | W | <i>S. noveboracensis</i> or <i>S. motacilla</i> | 0.02 |
| Tree Swallow | W | <i>Tachycineta bicolor</i> | 0.02 |
| Unknown swallow | W | | 0.02 |
| Roseate Spoonbill ^c | B | <i>Ajaia ajaja</i> | 0.02 |
| Common Snipe | W | <i>Gallinago gallinago</i> | 0.02 |
| Pied-billed Grebe | B | <i>Podilymbus podiceps</i> | 0.02 |
| Osprey ^c | B | <i>Pandion haliaetus</i> | 0.02 |
| Common Nighthawk | B | <i>Chordeiles minor</i> | 0.02 |
| Eastern Meadowlark | B | <i>Sturnella magna</i> | 0.02 |
| Laughing Gull | B | <i>Larus atricilla</i> | 0.02 |
| Clapper Rail | B | <i>Rallus longirostris</i> | 0.02 |
| Black Vulture | B | <i>Coragyps atratus</i> | 0.02 |
| Black-crowned Night-Heron ^c | B | <i>Nycticorax nycticorax</i> | 0.02 |
| American Bittern ^c | W | <i>Botaurus lentiginosus</i> | 0.02 |
| Cattle Egret | B | <i>Bubulcus ibis</i> | P |
| Glossy Ibis ^c | B | <i>Plegadis falcinellus</i> | P |
| Wood Stork ^c | B | <i>Mycteria americana</i> | P |
| Turkey Vulture | B | <i>Cathartes aura</i> | P |
| Bald Eagle ^c | B | <i>Haliaeetus leucocephalus</i> | P |
| Red-tailed Hawk | B | <i>Buteo jamaicensis</i> | P |
| American Kestrel | W | <i>Falco sparverius</i> | P |
| Merlin ^c | W | <i>Falco columbarius</i> | P |
| Peregrine Falcon ^c | W | <i>Falco peregrinus</i> | P |
| Black Rail ^c | B | <i>Laterallus jamaicensis</i> | P |
| Virginia Rail | W | <i>Rallus limicola</i> | P |
| Sora | W | <i>Porzana carolina</i> | P |
| American Coot | B | <i>Fulica americana</i> | P |

^aB = breeds on Merritt Island, W = species includes individuals that winter on Merritt Island; many individuals may only use Merritt Island during migration.

^bp = species sighted within the marsh while the investigator was transiting among stations, but not sighted while at a station.

^cSpecies of conservation concern (vulnerable to local, regional, or global extinction [Breininger et al. 1994]).

Table 1. (Continued) Bird abundances (mean sightings/visit) of birds sighted within an unimpounded salt marsh on Merritt Island, 1985-1986.

| Common name | Status ^a | Scientific name | Birds/visit ^b |
|--------------------|---------------------|------------------------------|--------------------------|
| Wilson's Plover | B | <i>Charadrius wilsonia</i> | P |
| Black-necked Stilt | B | <i>Himantopus mexicanus</i> | P |
| Spotted Sandpiper | W | <i>Actitis macularia</i> | P |
| Ring-billed Gull | W | <i>Larus delawarensis</i> | P |
| Gull-billed Tern | B | <i>Sterna nilotica</i> | P |
| Black Skimmer | B | <i>Rynchops niger</i> | P |
| Fish Crow | B | <i>Corvus ossifragus</i> | P |
| Sedge Wren | W | <i>Cistothorus platensis</i> | P |
| Marsh Wren | W | <i>Cistothorus palustris</i> | P |
| Common Grackle | B | <i>Quiscalus quiscula</i> | P |

^aB = breeds on Merritt Island, W = species includes individuals that winter on Merritt Island; many individuals may only use Merritt Island during migration.

^bp = species sighted within the marsh while the investigator was transiting among stations, but not sighted while at a station.

^cSpecies of conservation concern (vulnerable to local, regional, or global extinction [Breininger et al. 1994]).

within these marshes (Table 2). All species were observed feeding within the marsh except Royal Terns that occasionally used the marsh for loafing. Nearly all of the Common Yellowthroat sightings involved wintering birds that did not nest on Merritt Island (Breininger and Schmalzer 1990, Breininger and Smith 1992, Breininger 1992).

The effective detection distances ranged from 40 m to 60 m. The mean density of all birds combined for the entire year was 15 birds per ha. Densities of most birds were highest during the fall months and lowest during spring (Table 2). Fall had the highest total bird densities because of the seasonal abundance of ducks and shorebirds. Densities of Red-winged Blackbirds, Rufous-sided Towhees, and Boat-tailed Grackles were highest during summer. Red-winged Blackbirds had three times higher densities than did any other species. Only Red-winged Blackbirds, Rufous-sided Towhees, and Tricolored Herons were common throughout the year. Yellow-rumped Warblers had high densities in the winter.

DISCUSSION

Salt marshes are essential habitat for several species such as Clapper Rails, Sharp-tailed Sparrows, and Seaside Sparrows (Burger et al. 1992, Weller 1994). Although Merritt Island marshes no longer have Dusky Seaside Sparrows, they provided essential habitat for species of conservation concern including Black Rails, Black-wiskered Vireos, and Florida Prairie Warblers. Twenty-eight other birds in Merritt Island

Table 2. Bird densities (birds/ha) of the most common birds counted within an unimpounded salt marsh on Merritt Island, 1985-1986.

| Status | Species | Spring | Summer | Fall | Winter |
|---------------------------|------------------------|--------|--------|------|--------|
| Breederers within habitat | Red-winged Blackbird | 2.4 | 5.3 | 4.8 | 2.1 |
| | Willet | 0.2 | 0.2 | 4.3 | 0 |
| | Rufous-sided Towhee | 1.4 | 2.2 | 0.3 | 0.6 |
| | Boat-tailed Grackle | 0.2 | 1.4 | 0 | 0.1 |
| | Totals | 4.2 | 9.1 | 9.4 | 2.8 |
| Other local breeders | Tricolored Heron | 0.1 | 1.0 | 1.0 | 0.3 |
| | Royal Tern | 0 | 0 | 2.2 | 0 |
| | White Ibis | 0 | 1.6 | 0.5 | 0.1 |
| | Mottled Duck | 0 | 0.5 | 1.0 | 0 |
| | Totals | 0.1 | 3.1 | 4.7 | 0.4 |
| Winter residents | Yellow-rumped Warbler | 0 | 0 | 0.4 | 5.0 |
| | Blue-winged Teal | 0 | 0 | 4.6 | 0.1 |
| | Common Yellowthroat | 0.3 | 0 | 1.5 | 1.9 |
| | Western Sandpiper | 0 | 0 | 2.6 | 0 |
| | Palm Warbler | 0 | 0 | 0.6 | 1.0 |
| | Unknown Calidris | 0 | 0 | 1.5 | 0 |
| | Short-billed Dowitcher | 0 | 0 | 1.3 | 0 |
| | Least Sandpiper | 0 | 0 | 1.1 | 0 |
| | Dunlin | 0 | 0 | 1.0 | 0 |
| | Semipalmated Plover | 0 | 0 | 0.6 | 0 |
| | Totals | 0.8 | 0.0 | 15.2 | 8.0 |
| All birds | | 5.1 | 12.2 | 29.3 | 11.2 |

salt marshes are species of conservation concern not restricted to salt marshes (Breininger et al. 1994).

Eighty-nine avian species were sighted in Merritt Island salt marsh in comparison to 78 species seen in New Jersey (Burger et al. 1992) and 121 species in Texas (Weller 1994). Most birds sighted in salt marshes were the same in all three states. The higher diversity in Texas might be explained by a longer study period and the sampling of a greater diversity of wetland types (Weller 1994). For example, another 26 species not recorded in the Merritt Island salt marsh, were recorded in adjacent open water impoundments on Merritt Island (Breininger and Smith 1990). Many local breeders that did not nest in the marsh do nest in salt marsh vegetation on nearby islands (Breininger et al. 1994, Smith and Breininger 1995). The close proximity of open water, mudflats, grasses, shrubs, and trees was responsible for the high avian diversity found in this marsh. The high diversity of breeding birds using this marsh differs from low diversity associated with structurally simple marshes (Engstrom 1992).

Red-winged Blackbirds were dominant breeding birds in salt marshes at Merritt Island, New Jersey (Burger et al. 1992), and Texas (Weller 1994). Boat-tailed Grackles were also abundant breeding birds

at Merritt Island and Texas (Weller 1994). Rufous-sided Towhees were also abundant at Merritt Island because mangroves added a shrub and tree component to salt marshes.

Breeding bird counts have been performed near Merritt Island in the cordgrass (*Spartina bakeri*) marshes of the St. Johns National Wildlife Refuge (Leenhouts 1982a, Leenhouts 1992b). Spring and summer bird composition included Red-winged Blackbirds, Eastern Meadowlarks, King Rails (*Rallus elegans*), Black Rails, Common Yellowthroats, Rufous-sided Towhees, and Common Nighthawks. Black Rails were more common in the cordgrass marshes (Leenhouts 1982a, Leenhouts 1982b) compared to the salt marsh examined in this study.

Although no King Rails were sighted in the Merritt Island salt marsh, they occur in Merritt Island swale marshes (Breininger 1992). Swale marshes are narrow freshwater marshes within scrub-dominated landscapes. Green Herons were the only other species that occurred in higher densities in swale marshes than in salt marshes.

The densities of Tricolored Heron, White Ibis, Blue-winged Teal, Mottled Duck, Short-billed Dowitcher, and peeps (*Calidris* spp.) were similar in salt marsh and open water impoundments on Merritt Island (Breininger and Smith 1990). Willets were more abundant in salt marshes than in open water impoundments. Open water impoundments on Merritt Island lacked many species adapted to emergent salt marsh vegetation, but open water had greater waterbird densities than did the Merritt Island salt marsh. Compared to salt marshes, impoundments had higher densities of American Widgeon (*Anas americana*), Northern Pintail (*A. acuta*), Northern Shoveler (*A. clypeata*), Lesser Scaup (*Aythya affinis*) American Coot, Greater Yellowleg, Lesser Yellowleg, Killdeer, Semipalmated Plover, American Avocet (*Recurvirostra americana*), Black-necked Stilt, Snowy Egret, Great Egret, and Glossy Ibis (Trost 1968, Provost 1968, Breininger and Smith 1990, Smith and Breininger 1995).

Temporal variation in waterbird use is influenced by rainfall, water level management practices, movements of local and migratory populations, and changes in overall population size (Clark 1979, Girard and Taylor 1979, Paul et al. 1979, Smith and Breininger 1988, Breininger and Smith 1990, Schikorr and Swain 1995). For Merritt Island salt marshes, shorebird densities were highest in fall when most impoundments were flooded for wintering waterfowl and too deep for shorebirds. For Merritt Island salt marshes, wading bird densities peaked in summer, similar to peak times that wading birds used the adjacent estuary (Smith and Breininger 1990, Schikorr and Swain 1995).

Total bird densities in Merritt Island salt marshes were comparable to habitats with high avian densities (Breininger and Smith 1990, 1992; Breininger and Schmalzer 1990, Burger et al. 1992). Perhaps

only large stands of homogeneous, emergent salt tolerant grasses (e.g., cordgrass) have low avian densities (Trost 1968, Provost 1968, Leenhouts 1982a, Leenhouts 1982b).

This study was too limited in duration and geographical extent to make broad conclusions regarding avian seasonal patterns in salt marshes. Densities from avian survey techniques should be interpreted cautiously owing to potential errors (Verner 1985). Secretive species such as rails, bitterns, and sparrows should be surveyed using additional methods, such as playback recordings (Manci and Rusch 1988). Despite study limitations, I conclude that natural Merritt Island salt marshes are important for the conservation of biological diversity, and they can provide habitat for large numbers of resident and migratory birds. Avian composition and abundance are likely to vary spatially because water levels, habitat structure, vegetative composition, and landscape patterns vary greatly in salt marshes (Brown and Dinsmore 1986, Craig and Beal 1992, Larson 1995, Schmalzer 1995). These sources of variation are relevant to conservation but they have received little study. Management activities in salt marshes are occurring across decades with little quantification of the effects on avian populations.

ACKNOWLEDGMENTS

This study was funded by NASA, administered by the Biomedical Operations Office at KSC. Thanks to B. Summerfield, D. Britt, C. Hall, H. Hill, R. Hinkle, W. Knott III, E. Stolen, P. Schmalzer, R. Smith, and T. Engstrom.

LITERATURE CITED

- AMERICAN ORNITHOLOGISTS' UNION. 1993. Thirty-ninth supplement to the American Ornithologists' Union *Check-list of North American Birds*. Auk 110:675-682.
- BREININGER, D. R. 1990. Avifauna of hammocks and swamps on John F. Kennedy Space Center. *Florida Field Nat.* 18:21-44.
- BREININGER, D. R. 1992. Birds of swale marshes on John F. Kennedy Space Center. *Florida Field Nat.* 20:36-41.
- BREININGER, D. R., AND P. A. SCHMALZER. 1990. Effects of fire and disturbance on plants and birds in a Florida oak/palmetto scrub. *Amer. Midl. Nat.* 123:64-74.
- BREININGER, D. R., AND R. B. SMITH. 1990. Waterbird use of coastal impoundments and management implications in east central Florida coast. *Wetlands* 10:1-19.
- BREININGER, D. R., AND R. B. SMITH. 1992. Relationships between fire and birds in coastal scrub and slash pine flatwoods in Florida. *Amer. Midl. Nat.* 127:233-240.
- BREININGER, D. R., M. J. BARKASZI, R. B. SMITH, D. M. ODDY, AND J. A. PROVANCHA. 1994. Endangered and potentially endangered wildlife on Kennedy Space Center: conservation of faunal integrity as a goal for biological diversity. NASA Technical Memorandum 109204. Kennedy Space Center, Florida.
- BROWN, M., AND J. J. DINSMORE. 1986. Implications of marsh size and isolation for marsh bird management. *J. Wildl. Manage.* 50:392-397.
- BURGER, J., J. SCHISLER, AND F. H. LESSER. 1992. Avian utilization on six salt marshes in New Jersey. *Biol. Conser.* 23:187-212.

- CLARK, E. S. 1979. Factors affecting the initiation and success of nesting in an east-central Florida wood stork colony. Pages 178-188. *In*: Proceedings of the 1978 Conference of the Colonial Waterbird Group (W. E. Southern, compiler). Nat. Mus. of Nat. Hist., Smithsonian Institution, Washington, D.C.
- CRAIG, R. J., AND K. G. BEAL. 1992. The influence of habitat variables on marsh bird communities on the Connecticut River estuary. *J. Field Ornithol.* 104:295-311.
- CRUIKSHANK, A. D. 1980. The Birds of Brevard County. Florida Press, Inc., Orlando.
- DEFREESE, D. E. 1991. Threats to biological diversity in marine and estuarine ecosystems of Florida. *Coastal Manage.* 19:73-101.
- ENGSTROM, R. T. 1992. Bird counts in Florida habitats: a review. Florida Game and Fresh Water Fish Comm. Nongame Wildlife Rept. NG88-022.
- GIRARD, G. T., AND W. K. TAYLOR. 1979. Reproductive parameters for nine avian species at Moore Creek, Merritt Island National Wildlife Refuge, Florida. *Florida Scientist* 44:84-102.
- KALE, H. W. II. 1988. Birds of the Indian River Lagoon. Pages 1-51. *In*: Volume III. Indian River Lagoon: estuarine monograph (D. D. Barile project director). Sea Grant Project R/ESP-1. Marine Resources Council, Melbourne.
- LARSON, V. L. 1995. Fragmentation of the land-water margin within the northern and central Indian River Lagoon watershed. *Bull. Mar. Sci.* 57:267-277.
- LEENHOUTS, W. P. 1982a. Cordgrass marsh I. *Amer. Birds* 36:99.
- LEENHOUTS, W. P. 1982b. Cordgrass marsh II. *Amer. Birds* 36:99-100.
- MANCI, K. M., AND D. H. RUSCH. 1988. Indices to distribution and abundance of some inconspicuous waterbirds on Horicon Marsh. *J. Field Ornithol.* 59:67-75.
- PAUL, R. F., H. W. KALE, II, AND D. A. NELSON. 1979. Reddish Egrets nesting on Florida's east coast. *Florida Field Nat.* 7:24-25.
- PROVANCHA, M. J., P. A. SCHMALZER, AND C. R. HINKLE. 1986. Effects of the December 1983 and January 1985 freezing air temperatures on selected aquatic poikilotherms and plant species of Merritt Island, Florida. *Florida Scientist* 49:199-212.
- PROVOST, M. W. 1967. Managing impounded salt marsh for mosquito control and estuarine resource conservation. Pages 163-171. *In*: Proceedings of the Louisiana State University marsh and estuary management symposium (J. D. Newson, ed.). Louisiana State Univ., Division of Continuing Education, Baton Rouge.
- PROVOST, M. W. 1969. Ecological control of salt marsh mosquitoes with side benefits to birds. *Proc. Tall Timbers Conf. on Ecol. Animal Control by Habitat Management*, 1969:193-206.
- REYNOLDS, R. T., J. M., SCOTT, AND T. A. NUSSBAUM. 1980. A variable circular-plot method for estimating bird numbers. *Condor* 82:309-313.
- ROBERTSON, W. B., JR., AND J. A. KUSHLAN. 1974. The southern Florida avifauna. Pages 414-452. *In* *Environments of South Florida, Present and Past* (P. J. Gleason, ed.). Miami Geological Soc., Memoir 2, Miami.
- SCHIKORR, K. E., AND H. M. SWAIN. 1995. Wading birds-barometer of management strategies in the Indian River Lagoon. *Bull. Mar. Sci.* 57:215-229.
- SCHMALZER, P. A. 1995. Biodiversity of saline and brackish marshes of the Indian river lagoon: historic and current patterns. *Bull. Mar. Sci.* 57:37-48.
- SMITH, R. B., AND D. R. BREININGER. 1988. Northern breeding range extension for the Roseate Spoonbill in Florida. *Florida Field Nat.* 16:65-67.
- SMITH, R. B., AND D. R. BREININGER. 1995. Wading bird populations of John F. Kennedy Space Center. *Bull. Mar. Sci.* 57:230-236.
- SWAIN, H. M. 1995. Reconciling rarity and representation: a review of listed species in the Indian River Lagoon. *Bull. Mar. Sci.* 57:252-266.
- SYKES, P. W., JR. 1978. Black Rail. Pages 114-115. *In* *Rare and endangered biota of Florida*. Vol. 2, Birds (H. W. Kale, II., ed.). Univ. Presses of Florida, Gainesville.

- SYKES, P. W., JR. 1980. Decline and disappearance of the Dusky Seaside Sparrow from Merritt Island, Florida. *Amer. Birds* 34:728-737.
- TROST, C. H. 1968. Study of wildlife usage of salt marsh on east coast of Florida before and after impoundment for mosquito and sandfly control. Final Report Bureau of Sport Fisheries and Wildlife, U.S. Fish and Wildlife Service Contract No. 14-16-0008-623.
- VERNER, J. 1985. Assessment of counting techniques. Pages 247-302. *In* Current ornithology, Vol 2. (R. F. Johnston, ed.). Plenum Press, New York.
- WELLER, M. W. 1994. Seasonal dynamics of bird assemblages in a Texas estuarine wetland. *J. Field Ornithol.* 65:388-402.
- WUNDERLIN, R. P. 1982. Guide to Vascular Plants of Central Florida. University Presses of Florida, Tampa.

The Florida Ornithological Society
is Proud to Announce Special Publication No. 6

FLORIDA BIRD SPECIES: AN ANNOTATED LIST

BY

WILLIAM B. ROBERTSON, JR.
GLEN E. WOOLFENDEN

The first complete and authoritative review of Florida's avifauna since Arthur Howell's 1932 *Florida Bird Life*. Treats over 660 species reported in the state. More than 140 species of non-native exotics. Essential for everyone interested in the modern status of Florida's native and introduced birds.

| | SOFT COVER | HARD COVER |
|-------------|------------|------------|
| FOS Members | \$14.95 | \$19.95 |
| Non-Members | \$17.95 | \$22.95 |

All orders add \$2.00 shipping and handling per book.

Florida residents add 7% sales tax to the total.

Make checks payable to Florida Ornithological Society.

Mail to:

F.O.S. SPECIAL PUBLICATIONS EDITOR
ARCHBOLD BIOLOGICAL STATION
P.O. BOX 2057
LAKE PLACID, FL 33862